BIOMASS COMPENDIUM

NORTHEAST INTERNATIONAL COMMITTEE ON ENERGY
COMITÉ INTERNATIONAL DU NORD-EST SUR L'ÉNERGIE

SIXTEENTH ANNUAL CONFERENCE
OF THE NEW ENGLAND GOVERNORS
AND THE
EASTERN CANADIAN PREMIERS
NEWPORT, RHODE ISLAND
JUNE 13-15, 1988

A SELECTION OF BIOMASS ENERGY PROJECTS LOCATED IN THE NEW ENGLAND STATES AND THE EASTERN CANADIAN PROVINCES

Honorable Edward D. DiPrete
Governor of Rhode Island

Honorable Michael S. Dukakis
Governor of Massachusetts

Honorable Judd Gregg
Governor of New Hampshire

Honorable Madeleine M. Kunin
Governor of Vermont

Honorable John R. McKernan, Jr.
Governor of Maine

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Honorable John M. Buchanan
Premier of Nova Scotia

Honorable Joseph A. Ghiz
Premier of Prince Edward Island

Honorable Frank McKenna
Premier of New Brunswick

Honorable Clyde Wells
Premier of Newfoundland and Labrador

New England Secretariat
New England Governors' Conference, Inc.
76 Summer Street
Boston, Massachusetts 02110
(617) 423-6900 Fax (617) 423-7327

Eastern Canadian Secretariat
Secrétariat de l'est du Canada
P.O. Box 2044
Halifax, Nova Scotia B3J 2Z1
(902) 424-5905 Fax (902) 892-3426

Sixteenth Annual Conference
of the New England Governors
and the
Eastern Canadian Premiers
Newport, Rhode Island
June 13-15, 1988

Resolution 16 - 1

WHEREAS, the Conference of New England Governors and Eastern Canadian Premiers established NICE 10 years ago to provide a mechanism for the review of energy matters common to the six New England states and five Eastern Canadian provinces; and

WHEREAS, the mandate of the Committee was to facilitate information exchange and encourage the development of alternative energy resources; and

WHEREAS, the Conference continues to support cooperative efforts to assess the ever-changing energy supply and demand issues in the region;

NOW THEREFORE BE IT RESOLVED THAT the conference of New England Governors and Eastern Canadian Premiers directs its Northeast International Committee on Energy to:

- ☐ convene an international roundtable on energy in the State of Maine in the spring of 1989; and to
- ☐ prepare a compendium of innovative biomass energy facilities in the region; and to
- ☐ undertake projects designed to highlight energy education programs in the states and the provinces.

BE IT FURTHER RESOLVED THAT the jurisdictions share the cost of these activities on an equal basis.

ADOPTION CERTIFIED BY THE 16th ANNUAL CONFERENCE OF NEW ENGLAND GOVERNORS AND EASTERN CANADIAN PREMIERS on June 14, 1988.

Edward D. DiPrete

Governor Edward D. DiPrete
CoChairman

Premier John M. Buchanan
CoChairman

BIOMASS COMPENDIUM

A selection of Biomass Energy Projects located in the New England States and the Eastern Canadian Provinces

Foreword

The conference of the New England Governors and the Eastern Canadian Premiers was established in 1973, when its first Annual Conference was held in Prince Edward Island. The Governors of the six New England states — Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont — and the Premiers of the five Eastern Canadian provinces — New Brunswick, Newfoundland, Nova Scotia, Prince Edward Island, Quebec — have been meeting since that time. These meetings evolved from the historic and expanding economic and cultural ties between the states and the provinces.

At their Annual Conference, the Governors and Premiers have discussed and acted on many energy issues. In 1978 the Governors and Premiers established the Northeast International Committee on Energy (NICE) comprised of senior energy officials from the eleven juridictions to provide a mechanism for the continued exchange of informaiton and joint action in energy matters.

Each New England state and Eastern Canadian province has identified examples of Biomass energy facilities in their jurisdiction. The following pages contain descriptions of these particular projects as well as an overview of each state and provincial Biomass energy program. Inclusion of a project of this book does not infer that it is superior to other similar projects which may exist within the representative states/provinces, but that it was selected to provide a broad picture of the wide-range of projects within the Region.

Connecticut

Maine

Commonwealth of Massachusetts

Newfoundland

Nova Scotia

Prince Edward Island

New Brunswick

Quebec

State of Rhode Island and Providence Plantation

Vermont

New Hampshire

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Overview

The use of wood for energy increased significantly during the 1970s in Connecticut, in response to the increasing cost of other fuels, particularly oil, during that period. Surveys conducted in 1979 and 1985 indicate that approximately 30% of residences in Connecticut use wood for energy.

Fuelwood use by industry in Connecticut has increased at a much slower rate, due in part to the relatively low price of fossil fuels in the 1980s. Eight of the ten facilities that burn wood for energy are wood products manufacturers.

With 1.8 million acres of forested land, Connecticut has a significant supply of wood. Research completed by professional foresters in the state indicates that substantial volumes of fuelwood could be harvested. Many foresters believe the use of wood for fuel can create markets for low-quality wood that is otherwise unmerchantable. The use of integrated forest management techniques provides the opportunity to harvest low-quality wood while simultaneously improving the quality of the forest.

Residential wood fuel use is expected to remain level in the near future due to the relatively low price of oil. After the recent period of only modest increases in the amount of wood fuel used by industries, it now appears that wood use by Connecticut firms may grow substantially during the next few years. This is primarily due to two factors: independent power producers have received favorable power sales agreements with electric utilities serving the State; and skyrocketing landfill costs are encouraging recycling of wood wastes.

There are currently three wood-fired power plants proposed in Connecticut totaling 69 MW. All three facilities plan to burn a mixture of recycled wood wastes and harvested wood chips.

Pinchbeck Cogeneration Project — Connecticut

Technology
Cogeneration

Location
Guilford, Connecticut

End User
Greenhouse, and electric utility
- Commercial Sector primarily

Proponent
William Pinchbeck (Owner)

Fuel
Wood chips

Alternate Fuel
Sawdust

Status
Operating

Description

Most of the energy produced by this project — both heat and electricity — are used on site in the company's greenhouse. Connecticut Light and Power Company buys the surplus electricity. The wood chips and sawdust are delivered by tractor trailer, the fuel is stored in an outside site, and the boiler is fed by screw auger. Combustion is in a retrofit International coal boiler. Average plant heat output is 10 million BTU per hour. Steam output is 10,000 lb/hr at 120 psig.

Costs

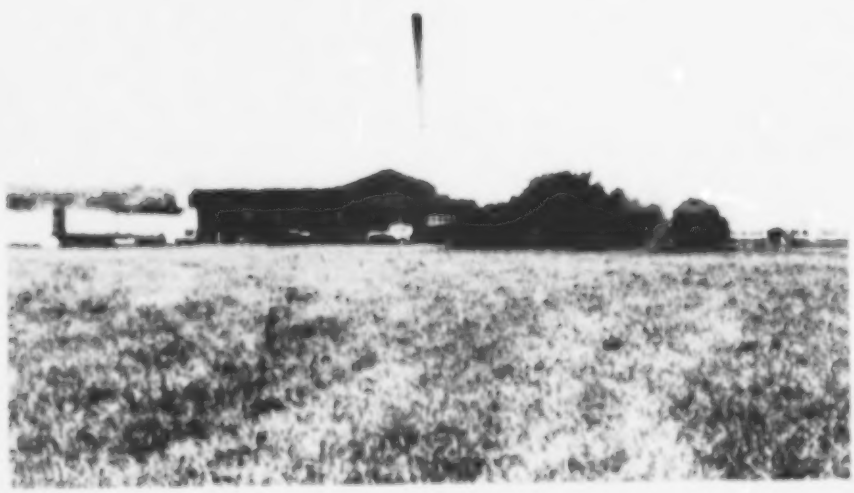
1988 wood fuel cost was $66,000 (US)

Benefits/Savings

The system has a maximum electrical output of 150 kW and consumes approximately 3000 tons of wood chips and 3000 tons of sawdust per year.

Information Contact

William Pinchbeck
929 Boston Post Road
Guilford, CT 06437



Bio-Gen Torrington Partnership — Connecticut

Technology
Small power production

Location
Torrington, Connecticut

End User
Connecticut Light and Power Company
- Utility

Proponent
Bio-Gen Torrington Partnership
- Commercial Sector

Fuel
Whole tree chips, harvesting residues, sawmill residues, sawdust, recycled urban wood waste

Alternate Fuel
#2 oil for start-up and flame integrity

Status
Planned

Description

The planned project would produce 13 MW of electricity. All electricity produced by the plant (other than that needed to run the plant) would be sold to Connecticut Light and Power.

Costs

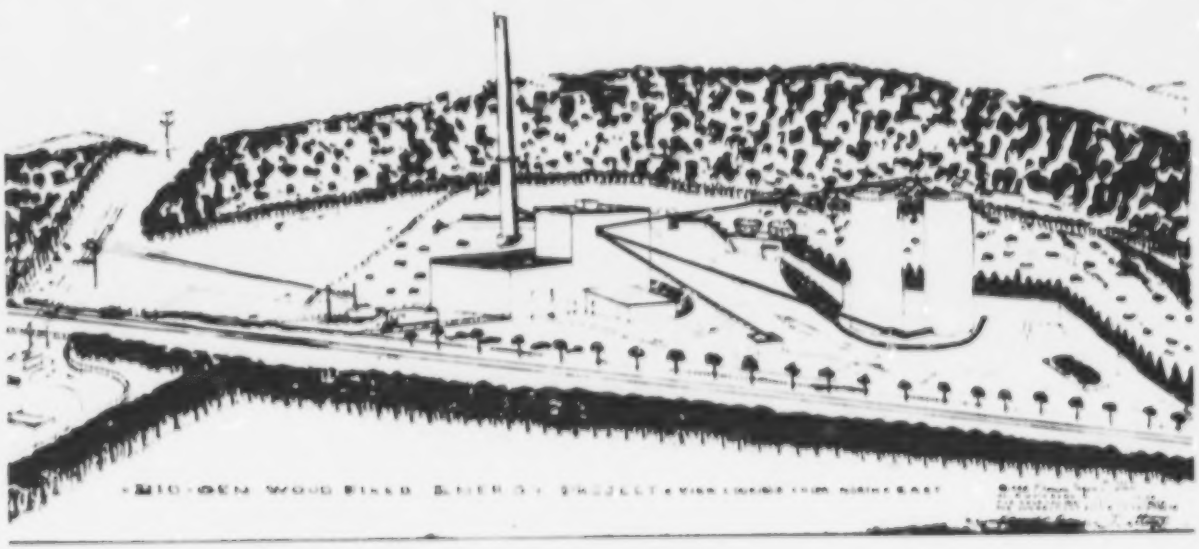
Expected yearly operating costs are $518,734 (US).

Benefits/Savings

The system's maximum electrical output is 13 MW and would consume about 125,000 tons of biomass per year.

Information Contact

Aaron Samson, President
Bio-Gen Torrington Partnership
269 Old Canterbury Turnpike
Norwich, CT 06360
Phone: (203) 237-5580



Uniroyal Cogeneration CCF-3, Inc. — Connecticut

Technology
Cogeneration

Location
Naugatuck, Connecticut

End Users
Uniroyal will purchase process steam
- Industrial Sector

Connecticut Light and Power will purchase electricity
- Utility

Proponent
CCF-3, Inc.

Fuel
Whole tree chips, sawdust, bark, and chipped slabs

Alternate Fuel
Coal (for standby; 100,000 tons per year)

Status
Planned

Description

The 24 MW facility will consist of a single 300,000 lb/hr (maximum capacity) fluidized bed steam generator driving a single 24,000 kW extraction/condensing steam turbine generator; a cooling tower; a combination boiler house and turbine hall; a fuel handling system to receive, process, store, retrieve and meter the biomass fuel; and equipment to control, meter, and distribute the facility's electric power.

Costs

Annual cost of fuel may be $6,300,000 (US) per year

Benefits/Savings

24 MW of electric power will be produced. 400,000,000 lbs of saturated steam (at 256 psig) will be available annually for sale to Uniroyal. The plant will use between 250,000 and 350,000 tons of wood chips per year.

Information Contact

Joel M. Canino, President
CCF-3, Inc.
One Research Parkway
Meriden, CT 06450
Phone: (203) 237-5580

ARS - Killingly Energy Limited Partnership — Connecticut

Technology
Small power production

Location
Killingly, Connecticut

End User
Connecticut Light and Power Company
- Utility

Proponent
ARS - Killingly Energy Limited Partnership
- Commercial Sector

Fuel
Whole tree chips, urban wood waste, sawmill residues

Alternate Fuel
#2 oil for start-up and flame integrity

Status
Planned

Description

This planned project would produce 32.2 MW of electricity. This would be sold to Connecticut Light and Power.

Costs

Planned costs to operate the plant are $6,500,000 (US) per year.

Benefits/Savings

32.2 MW of electrical power produced; 400,000 tons of biomass consumed.

Information Contact

William B. Hull, President
Hull Forest Products, Inc.
RR1, Box 106
Pomfret, CT 06259
Phone: (203) 974-0127

State of Maine

Overview

Maine is the most heavily forested state in the United States. Approximately 89 percent of its total land area is forest land. Situated between the boreal forest of Canada and the hardwood forest of the eastern United States, Maine's 17 million acres of forest land contain a broad mixture of softwoods and hardwoods. With over 16 million acres of commercial timberland as a natural resource, it is no wonder that Maine for many years has made use of biomass fuel in its forest-related products industries and more recently in independent (non-utility) power production.

In 1989, thirty-one biomass operations in the State of Maine are non-utility power producers. Of these, one burns peat, four burn municipal waste, and the remaining twenty-six plants burn wood — either mill residues or whole tree chips. Of these 31 operating biomass plants, 22 are classified as cogeneration and 9 as small power producers. Presently, 640 MW or 23 percent of the state's electric capacity is fueled by wood. In the last two decrements bid by Maine's largest electric utility, six additional biomass plants of 15.3 MW each were contracted.

Substantial residential space heating also draws heavily on the wood supplies of this state. According to surveys, in the early 1980s over half of the households heated with wood, wholly or partially. By 1986-87, with lower oil prices, annual surveys indicated a leveling off at about 42 percent.

In the spring of 1989, a new venture began with the start-up of a peat energy plant in DeBlois, Maine. The plant's entire 22.8 MW capacity is contracted to Boston Edison Electric Company of Massachusetts via an innovative transmission arrangement with the Bangor Hydro-Electric Company of Maine.

In Maine, as elsewhere, the waste-to-energy picture is unsettled. Of Maine's four operating plants, three are power producers, while one produces only processed steam. It will continue to do so until renovations are completed in 1991. The longevity of these plants will be determined by the availability of ash disposal facilities rather than by the need for, or cost of, electricity.

The State of Maine is a recognized leader in biomass energy production. And, as power production activity is further developed, the importance of biomass fuels to the State will continue to grow.

Down East Peat Project

State of Maine

Technology
Electrical Generation

Location
DeBloise, Maine

End User
Boston Edison
- Electric Utility

Proponents
Peat Products of America
ACEC
Transco Energy Ventures Co.
- Commercial Sector

Fuel
Peat

Alternate Fuel
Wood Chips

Status
Operating

Description

The Down East Peat Project is the first peat-fueled electric power plant to be built in the United States. Located in Washington County, Maine, the 22.8 MW plant produces power under contract with Boston Edison of Massachusetts through special transmission arrangements with Maine's Bangor Hydro-Electric Company.

During start-up the plant was fueled by wood chips. Its goal, however, is to be fueled entirely by peat excavated from the adjacent Denbo Heath and surrounding bogs. In full operation, the power plant is expected to burn 165,000 tons of peat per year.

While the power plant was in the construction stages, extensive research and development was conducted by Down East Peat Products in preparing the bog for harvesting and in adapting special equipment for the Maine harvesting operation.

Costs

Estimated at more than $55 million (US).

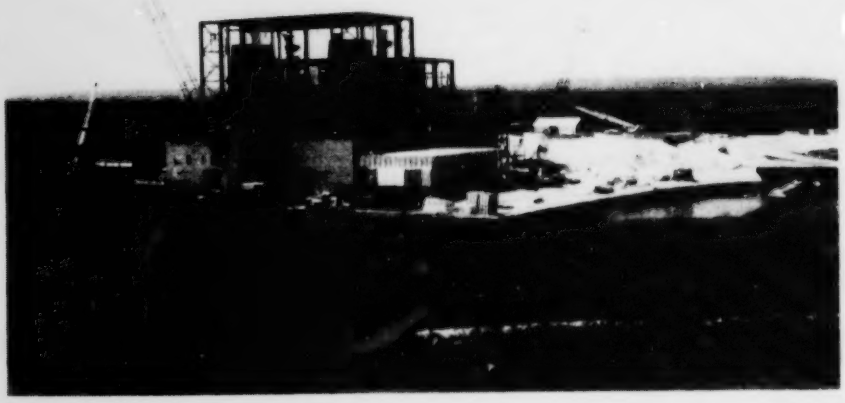
Benefits/Savings

In a relatively remote area of the state, about 80 full-time jobs have been created. More are anticipated during the five month harvest season. In addition, between one half million and one million dollars in taxes will be paid in 1989.

Since peat is not considered a renewable resource, permits required from the U.S. Army Corps of Engineers and from the Maine Department of Environmental Protection required that Down East Peat establish a $50,000 fund to mitigate for the loss of wetlands at Denbo Heath. Most of the mitigation funds are being combined with other monies for the purchase of land, while some is being set aside for educational purposes.

Information Contact

Paul LePage
President and Chief Executive Officer
Down East Peat LP
Lane Road
Box 45D
DeBlois, Maine 04622



Babcock Ultrapower — Two Plants

State of Maine

Technology

Electrical generation
Maine

Location

Jonesboro and West Enfield.

End User

Bangor Hydro-Electric Company
- Electric Utility

Proponents

Babcock and Wilcox (Mfgr.)
Maine Power Services (Operator)
- Commercial sector

Fuel

Whole tree chips and wood residue

Status

Operating

Description

Maine Power Services operate the Babcock Ultrapower biomass power plants in Jonesboro and West Enfield. The plants are the first two Ultra Systems plants sited, and are regarded as mirror images of one another. (Only a few subtle differences in siting distinguish the 24.5 MW plants.) The plants use circulating fluidized bed technology. Each took 2 years to construct, and they began producing power about the same time in late 1986.

Costs

Each plant was constructed at a reported cost of $50.8 million (US).

Benefits/Savings

The circulating fluidized bed technology is lauded as being of great benefit in controlling emission levels. Maine Power Services points out that the 800 tons of wood consumed per day displaces approximately 288,000 barrels of oil per year.

Information Contact

Roger W. Day
General Manager
Maine Power Services
2A Evergreen Woods
700 Mt. Hope Avenue
Bangor, Maine 04401

Fairfield Energy Venture, L. P.

State of Maine

Technology
Electrical Generation

Location
Fort Fairfield, Maine

End User
Central Maine Power Co.
- Electric Utility

Proponent
U.S. Energy Corporation,
Operations and Engineering Operator
- Commercial Sector

Fuel
Wood chips, harvest residues, and mill residues

Alternate Fuel
#2 Diesel fuel

Status
Operating

Description

Fairfield Energy Venture, L.P., is rated as a 30 megawatt generating station.

Completed in November, 1987, the 328,000 lbs/hr wood-fired boiler uses 1000 tons of wood chips, harvest residues, and mill residues daily. Operating pressure is 1500 psi at 900 degrees F. Fuel is contracted with three major suppliers, which draw on resources within a one hundred mile radius.

The generator is a Westinghouse 13.8 kV design with a rated output of 37.5 kVA.

Costs

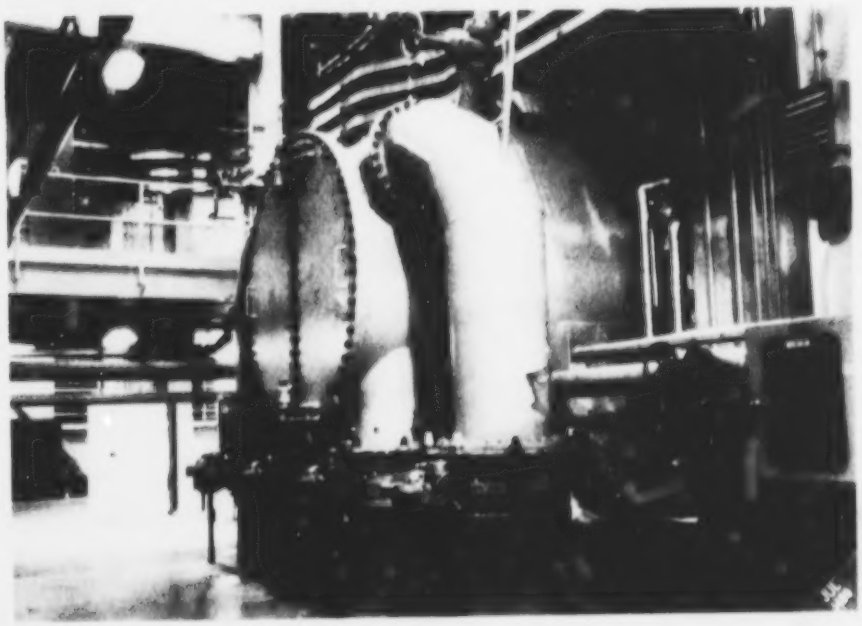
Project costs are reported at nearly $60 million (US).

Benefits/Savings

Fairfield Energy Venture is one of the largest biomass facilities in the state, and employs thirty-eight local people. The 365,000 tons of biomass fuel consumed each year replaces the 360,000 barrels of oil which a conventional oil-fired power plant of comparable size would require.

Information Contact

Richard V. Lombard
Business Manager
U.S. Energy Corporation
Operations and Engineering Division
Cheney Industrial Park
P.O. Box 492
Fort Fairfield, Maine 04742



Commonwealth of Massachusetts

Overview

Massachusetts features both substantial urban areas, such as Greater Boston, and significant rural areas, mostly in the western part of the state. Approximately 64% of the state is forested. Forest acreage totals 3.2 million acres. Wood burning increased noticeably in the late 1970s and 1980s in residences and industries. A decrease in fossil fuel prices since then caused some wood burners to convert back to oil or gas. Industrial/commercial wood fuel use totaled 65,000 tons/year in 1988; residential wood fuel use totaled 95,000 tons/year in 1988.

A substantial source of biomass energy in Massachusetts comes from the incineration of municipal solid waste. As of March 1989, privately-funded resource recovery facilities were in operation, converting the latent energy in 7,000 tons/day of municipal solid waste to steam and electricity. Environmental overview is provided by the Executive Office of Environmental Affairs through the Division of Solid Waste Management.

Biomass work within the Commonwealth of Massachusetts Executive Office of Energy Resources (EOER) is directed towards both wood fuel, and resource recovery from municipal wastes. Program funds are provided from several sources: the Coalition of Northeastern Governors (CONEG), Northeast Region Biomass Program (NRBP), oil overcharge funds, and the Alternative Energy Property Program (AEPP).

Recent programs include:

(1) A "High-Tech" Woodstove Workshop, co-sponsored with NRBP, for manufacturers, service people, and retailers to familiarize the trade with new EPA-mandated restrictions on emissions. The Director of Energy Conservation Technology at Canada's Energy Research Laboratories was a featured speaker.

(2) Cogeneration of electricity and heat from biogas derived from anaerobic digestion of sewer sludge at the Northampton Wastewater Treatment Plant.

(3) Cogeneration at state-owned facilities comparatively evaluating the use of wood in combination with coal as a fuel.

(4) The potential for siting waste-to-energy facilities based on the consumption of commercial wastes on state-owned properties, a program undertaken in cooperation with the Executive Office of Environmental Affairs and their Division of Solid Waste Management.

(5) The recovery of waste heat from the incineration of sewer sludge at the Greater Lawrence Sanitary District Wastewater Treatment Plant.

Cogeneration Utilizing Biogas, Northampton

Commonwealth of Massachusetts

Technology

Cogeneration of 100 kW of electricity utilizing packaged generator-sets equipped with heat recovery systems

Location

Northampton, Massachusetts

End User

The Hockanum Waste Treatment Plant

Proponent

The City of Northampton, Massachusetts
- Municipal Government

Fuel

Biogas generated by the anaerobic sludge digester

Status

Under development

Description

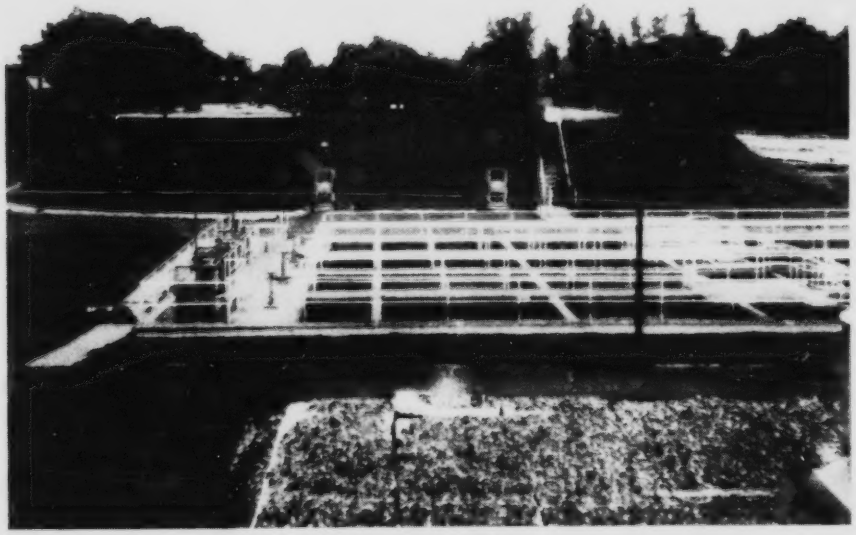
This municipal wastewater treatment plant processes approximately 5,000,000 gallons per day. Anaerobic digestion of sludge produces approximately 40,000 cf/d of biogas, which fuels a package cogeneration module consisting of an engine and synchronous generator, providing electricity and heat for on-site use.

Commonwealth of Massachusetts

Information Contact

James Dostal
Plant Manager
Hockanum Wastewater Treatment Plant
Hockanum Road
Northampton, MA 01060
Phone: (413) 586-6950

Irving Sacks
Biomass Program Manager
Executive Office of Energy Resources
100 Cambridge Street
Boston, MA 02202
Phone: (617) 727-4732



Electric Power from Municipal Solid Waste, Rochester

Commonwealth of Massachusetts

Technology

Steam production by shred-and-burn technology

Location

Rochester, Massachusetts

End User

Commonwealth Electric Company
- Electric utility

Proponent/Developer

Energy Answers Corporation
- Commercial Sector

Fuel

Municipal solid waste

Status

Facility has commenced full operation

Description

An incinerator burning refuse-derived fuel (RDF) consumes up to 1800 tons per day of municipal solid waste. (An expansion to 2700 tons/day is being negotiated.) Air pollution control is accomplished by dry scrubbers and electrostatic precipitators. A material recovery facility near the RDF plant is being explored. This plant will accept separated material on a community-by-community basis. Extensive metals recycling is carried on. Ash re-uses are being developed.

Commonwealth of Massachusetts

Information Contacts

Susan King
Energy Answers Corporation
Route 28
Rochester, MA 02770
Phone: (508) 291-2190

Geri Lambert
Commonwealth of Massachusetts
Division of Solid Waste Management
1 Winter Street
Boston, MA 02108
Phone: (617) 292-5979

Electric Power Production, Millbury

Commonwealth of Massachusetts

Technology

Steam production by mass burn technology
(Von Roll process)

Location

Millbury, Massachusetts

End User

New England Power Co.
- Electric utility

Proponent

Wheelabrator Environmental Systems, Inc.
- Commercial sector

Fuel

Municipal Solid Waste

Status

Commenced full operation in January 1988

Description

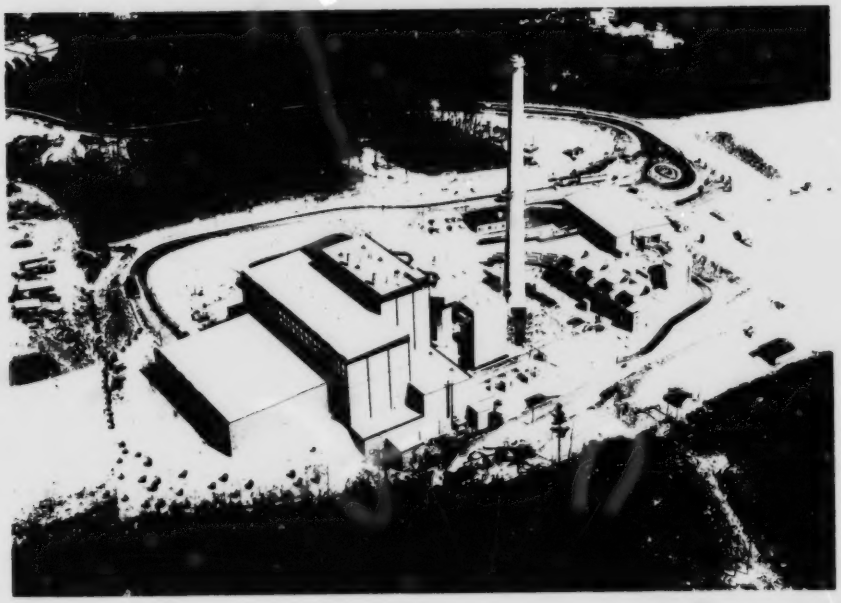
A mass-burn incinerator, consuming up to 1500 tons per day of municipal solid waste. Air pollution control is accomplished by dry scrubbers and electrostatic precipitators.

Commonwealth of Massachusetts

Information Contacts

John O'Sullivan
Wheelabrator Environmental Systems, Inc.
P.O. Box 740
Millbury, MA 02157
Phone: (508) 791-8900

Geri Lambert
Commonwealth of Massachusetts
Division of Solid Waste Management
1 Winter Street
Boston, MA 02108
Phone: (617) 292-5979



Electric Power from Municipal Solid Waste, Haverhill and Lawrence

Commonwealth of Massachusetts

Technology
Steam production by mass burn technology (Martin Process)

Location
Haverhill, and Lawrence, Mass.

End User
New England Power Company - Electric Utility

Proponent
Ogden Haverhill Associates - Commercial Sector

Fuel
Municipal solid waste

Status
Operating

Description

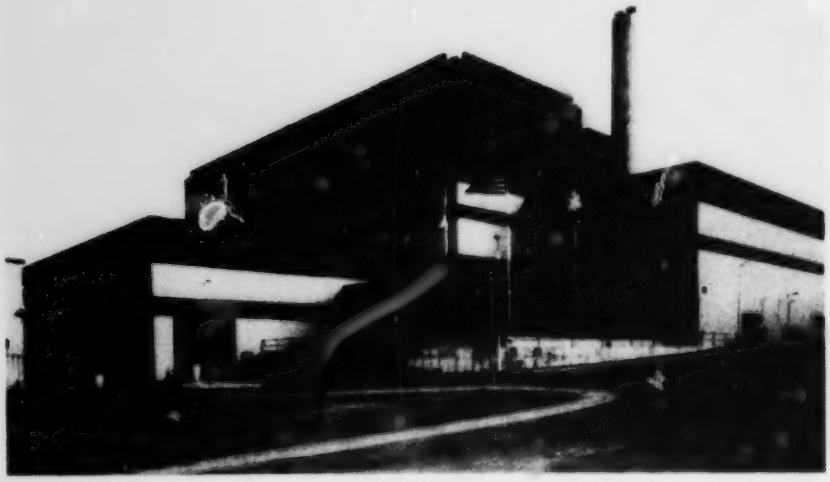
The original plant was operated from 1984-1987 by a former owner. The plant was taken out of service and modified, with full service restored in April 1988. Authorized capacity of this mass burn incinerator is 1650 tons per day. Waste is processed at the Haverhill facility, and burned at the Lawrence RDF (Refuse-Derived Fuel) facility. Air pollution control is accomplished by dry scrubbers and electrostatic precipitators.

Commonwealth of Massachusetts

Information Contacts

Tom White
Business Manager
Ogden Haverhill Associates
100 Recovery Way
Haverhill, MA 01830
Phone: (508) 372-6288

Geri Lambert
Commonwealth of Massachusetts
Division of Solid Waste Management
1 Winter Street
Boston, MA 02108
Phone: (617) 292-5979



Overview

Developments in biomass energy in New Brunswick have centered around the use of wood residue from the forest products industry, and more recently from forest harvesting operations. The Province of New Brunswick supports the use of wood residue to the extent that it does not compete with uses for higher value products. Substantial volumes of residue with no other market use in the foreseeable future have been identified for use as fuel. The Department of Natural Resources and Energy develops and maintains resource supply and demand information and sponsors research and development in the harvesting of residue and its conversion to energy.

It has been determined through this work that there is a sustainable annual supply of more than 3 million dry metric tonnes (dt) of wood residue available from the forest industry. One million dt is in the form of sawmill residue with the remainder from forest harvesting operations. The present consumption of wood residue for energy is near to one million dt per year with the majority of the use occurring in the pulp and paper industry. Between 60,000 and 80,000 dt is used in the institutional sector annually.

Other biomass activity has developed more recently in the field of anaerobic waste water treatment of pulp and paper plant waste. This innovative technology is being demonstrated at the Consolidated-Bathurst Inc. plant in Bathurst, N.B. where the biogas is being collected at the waste-water treatment plant and used to fuel a flash dryer in the mill. Technologies such as this have great potential, and demonstrate that energy and environmental solutions can go hand in hand.

Biogas-Fired Flash Dryer

New Brunswick

Technology
Anaerobic waste water treatment of pulp and paper mill effluent, with biogas recovery.

Location
Bathurst, N.B.

End User
Consolidated-Bathurst Inc.
- Industrial Sector

Proponent
Consolidated-Bathurst Inc.
- Industrial Sector

Fuel
Biogas

Status
Construction complete, start-up in progress

Description

Consolidated-Bathurst Inc., has installed, as part of a modernization program, an anaerobic effluent treatment facility to replace their aerobic process. The new method uses considerably less energy to operate, and produces biogas as a by-product. This phase of the project involves the demonstration of the use of the biogas to fuel the pulp flash dryer. The operation of the system will be monitored extensively, and the results will be publicized throughout the industry.

Costs

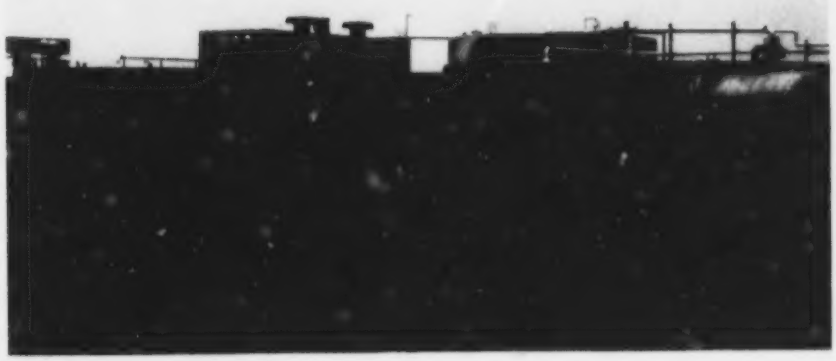
Gas utilization equipment:	$1,017,300	(CDN)
Monitoring and technology transfer:	70,000	
Total:	$1,087,300	
Federal/Provincial contribution:	220,400	

Benefits/Savings

Projected biogas production is 26,200 cubic meters per day, displacing 16,750 liters of oil per day, equal to 60% of consumption. 34,000 barrels of oil displaced per year.

Information Contact

R.F. Meares
Manager of Projects
Consolidated-Bathurst Inc.
P.O. Box 69
Montreal, Quebec H3B 1Y9



Wood-Fueled Boiler

New Brunswick

Technology
Wood residue combustion, space heating

Location
Bathurst, N.B.

End User
Chaleur Regional Hospital - Institutional Sector

Proponent
Chaleur Regional Hospital - Institutional Sector

Fuel
Sawmill wood residue

Status
Operational; installed 1986

Description
Installation of a 300 boiler horsepower wood-residue fueled boiler, and connection of the steam plant to a nearby nursing home.

Costs

$980,000 (CDN)

Benefits/Savings

Annual wood residue consumption is 2500 dry tonnes (dt) or 2750 dry Tons, displacing 6900 barrels of bunker C oil.

Information Contact

Raoul Benoit
Plant Superintendent
Chaleur Regional Hospital
Bathurst, N.B.

Wood-Fueled Boiler

New Brunswick

Technology

Wood fueled district heating

Location

Fredericton, N.B.

End User

University of New Brunswick
St. Thomas University
Dr. Everett Chalmers Hospital
Research and Productivity Council
DNRE Soils Lab
- Institutional/Government

Proponent

University of New Brunswick
- Institutional

Fuel

Sawmill wood residue

Status

Operating since 1984

Description

A 40,000 lb/hour, Babcock and Wilcox boiler was installed at the central heating plant on the UNB campus. The wood boiler is base loaded, with the oil-fired boilers carrying the peak demand. Two concrete storage silos were installed to provide 3 days fuel reserve in mid winter. Steam from the plant is used for space heat in winter and air conditioning in summer.

Costs

Total Cost: $2,420,000 (CDN)
Federal/Provincial contribution: $535,000

Benefits/Savings

Annual wood residue consumption is 18,000 dry tonnes (dt), or 19,800 dry Tons, displacing 48,300 barrels of bunker C oil.

Information Contact

Fred Pollitt
Central Heating Plant
University of New Brunswick
Fredericton, N.B. E3B 6C2

Wood-Fueled Boiler

New Brunswick

Technology
Wood-residue fueled boiler

Location
Fredericton, N.B.

End User
Hugh John Flemming Forestry Centre
- Commercial/Institutional

Proponent
Maritime Forestry Complex Corporation
- Commercial/Institutional

Fuel
Whole-tree wood chips

Status
Operating since 1986

Description

A 200 boiler horsepower wood-residue fired boiler is used to provide space heat for the 350,000 sq. ft. complex. The fuel is 100% whole tree chips recovered from low grade trees on the University of New Brunswick woodlot.

Costs

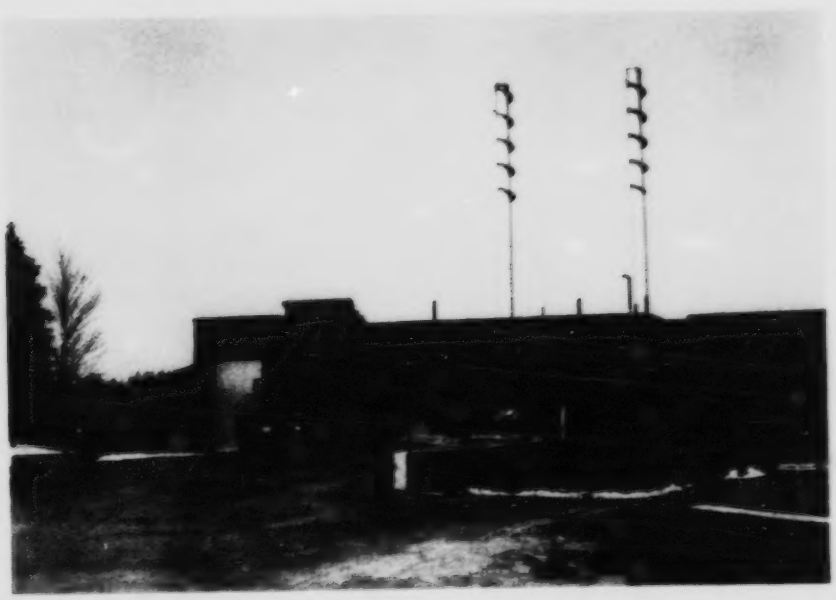
Total wood/oil plant cost: $1,480,000 (CDN)

Benefits/Savings

Annual consumption of wood fuel is 2500 dry tonnes (dt) or 2750 dry Tons, displacing 6900 barrels of oil.

Information Contact

Hank Nason
Maritime Forestry Complex Corporation
R.R. No. 10
Fredericton, N.B.



Overview

For the past six years the New Hampshire biomass program has concentrated in developing the state's most abundant natural resource into a productive source of alternative fuel. The large area of overstocked forest land has been in need of silvicultural work for some time. The opportunity to harvest this low quality material has been enhanced by the relatively high electric utility buy-back rates (also known as PURPA rates) and the dedication of some of the developers. In the past three years the state has seen the completion of six wood-fired small power producers with a combined capacity of approximately 90 megawatts. In addition, there are six other industrial cogeneration facilities that have been on line since before 1984. This brings the combined capacity of these facilities to approximately 130 megawatts, or 8% of peak demand in the state. In addition to the 2.4 million tons burned annually in these facilities, another 200,000 to 300,000 tons are burned in about 60 other smaller commercial and industrial applications. Many of these are sawmills and other wood product manufacturers. Most of the wood burned in this sector is sawmill or other wood waste.

Of the total estimated 2.7 million tons of wood that are burned each year, 1.8 to 2.0 million tons are whole tree wood chips. The annual consumption of wood has grown from 700,000 tons per year in the past five years.

Additionally, the state has seen the development of mass burn municipal solid waste facilities. Two are currently on line, with one soon to begin commercial operation and several more in the planning stages. This and strong recycling efforts will aid communities that are struggling with the problems of solid waste disposal.

Each year a residential fuel survey is conducted, and through this the use of wood is closely monitored. This survey has become the major source of information on the use of wood as a home heating fuel. The survey for the 1987-1988 heating season showed a drop in wood burned to 400,000 cords. This was down from 575,000 cords the year before, and an all time high of 640,000 cords that were burned in the winter of 1984-1985.

Pinetree Power — Tamworth

New Hampshire

Technology
Electricity generation

Location
Tamworth, NH

End User
Public Service Company
of New Hampshire
- Electric Utility

Proponent
Westinghouse
- Industrial sector

Fuel
Whole tree wood chips

Status
Operating

Description

This 20 megawatt wood-fired plant is the largest small power producer in the state. The plant produced its first power late in 1987 and began commercial operation in early 1988. The plant was constructed in seven months from ground breaking to electrical generation.

The owners are instituting a wood procurement system that includes land owner assistance programs. The plant recently received permission to increase its electrical output and is negotiating the sale of the excess electricity.

Costs

$20 - $30 million (US)

Benefits/Savings

In addition to the 20 megawatts of electrical capacity, roughly $5.0 million is spent each year on a local renewable fuel source.

Information Contact

Eric Heggeseth
Phone: (603) 323-8187

Society for the Protection of New Hampshire Forests (SPNHF)

Technology
Space heat

Location
Concord, NH

End User
SPNHF
- Non-profit/Educational sector

Proponent
SPNHF
- Non-profit/Educational sector

Fuel
Wood chips

Alternate Fuel
Solar

Status
Operating

Description

This 7,000 square foot office building and conference center was designed to be a showcase for solar energy technology and energy conservation. The original pellet-burning furnace was replaced with a 150,000 BTU wood chip gasification unit. The wood chips are hand fed into the gasification unit from an outdoor storage pile. Approximately 14 tons of wood are burned each year. Both this and the original unit have provided supplemental heat: solar supplies the other 80% of the total heating load of the building.

Costs

$2,000 (US)

Benefits/Savings

No fossil fuels are used to heat the building. Solar provides approximately 80% of the energy, with wood being the backup.

Information Contact

Steve Blackmer
Phone: (603) 224-9945

Bridgewater Steam — New Hampshire

Technology
Electrical Generation

Location
Bridgewater, NH

End User
Public Service Company of New Hampshire
- Electric Utility

Proponent
G2S Construction
- Industrial sector

Fuel
Whole tree wood chips

Status
Operating

Description

This 12.5 megawatt wood-fired plant came on line in the fall of 1987. The owners designed their plant to be non-intrusive and aesthetically pleasing. Located near a major interstate highway, it is barely visible. Features such as a concrete smoke stack and storage silos and a well constructed boiler room limit any noise disturbance to the immediate grounds of the facility.

Since beginning operation, this plant has maintained an excellent availability rating, and generated over 100 million kWh in 1988. This was the most for any small power producer in the state.

Costs

$15 - $20 million (US)

Benefits/Savings

In addition to the 12.5 megawatts of electrical capacity, roughly $3.5 million is spent each year on a local renewable fuel source.

Information Contact

Paul Cavicchi
Phone: (603) 528-2404

Concord Steam Corporation — New Hampshire

Technology
Cogeneration of electricity and district heating

Location
Concord, NH

End User
Concord Electric
- Electric utility.

Proponent
Concord Steam
- Utility/Commercial

Fuel
Whole tree wood chips and sawmill residues

Alternate Fuel
#6 Oil

Status
Operating

Description

For over 50 years, the New Hampshire Hospital generated its own steam and electricity using a boiler plant that was converted from coal to oil in the 1950s. During this period, Concord Steam Corporation operated from a downtown location, generating and selling steam to a number of commercial, institutional and industrial clients in the downtown area. In its search for a new plant location, Concord Steam approached New Hampshire Hospital and proposed a lease agreement that would include a conversion of the existing hospital boilers to wood fuel.

As a result of this agreement and a subsequent agreement to lease the Hospital's generating equipment to Concord Steam, a number of benefits accrued to both parties and to the Concord community. These benefits include the expansion of the utility's steam service to include two major hospitals as well as its former service area. This improved the boiler plant capacity ratio, reduced labor costs and operating losses, and provided an increase in the tax base for the City of Concord.

The additional lease of the Hospital's electrical generating plant provides even further improvements in energy efficiency, including the installation of a wood-fired high pressure steam boiler that cogenerates electricity prior to distributing steam to customers.

Benefits/Savings

1.5 megawatts of electricity are generated, and the purchase of 70,000 barrels of oil is avoided.

Information Contact

Peter Bloomfield
Phone: (603) 224-1461

Overview

Biomass energy use in Newfoundland (1988) is equivalent to 1 million barrels of oil annually, which at $22 CDN per barrel represents a displacement value of $22 million. Still greater potential exists in the province for the substitution of biomass for conventional fuels.

Current biomass fuel consumption has been estimated at 590,000 green tonnes of wood and about 5,000 green tonnes (equivalent) of peat. The allocations for total provincial (1986) net energy demand (120 PJ) is 64% petroleum products, 30% electricity, and 6% biomass.

The residential sector is the largest biomass fuel user, consuming roughly 360,000 green tonnes each year. In 1988, an estimated 38,000 households (23%) used biomass as the principal heating source. Another 35% used petroleum products for heating and 42% were electrically heated.

Productive forest areas in the province with a fibre yield not less than 35 cubic metres per hectare encompass 2.9 million hectares. The exact quantity of fuel-grade wood is not known; it is estimated, however, that from 15 to 35 million green tonnes are available, along existing roads, within 80 km of major central and west coast centres.

The province also has over 2 million hectares of peatlands. There is an estimated 11 billion cubic metres of peat on the island, of which 5,700 million cubic metres (52%) is classified as fuel peat. This is equivalent to 2 billion barrels of petroleum products.

The province is actively involved in biomass fuel utilization projects and inventory studies. Projects showing greater use of waste wood and wood-fired cogeneration are some of the demonstrations presently being implemented. Fuelpeat research and development is also ongoing; it includes peat pyrolysis research, the development of improved peat harvesting techniques, and the testing and demonstration of peat-burning appliances.

Eastern Community College Wood Boiler

Newfoundland

Technology
Space Heating

Location
Clarenville, Nfld.

End User
Eastern Community College
- Institutional Sector

Proponent
Dept. of Works, Services, and Transportation
- Provincial Government

Fuel
Whole tree chips

Alternate Fuel
#2 Oil

Status
Temporarily shut down due to feed system difficulties

Description

This containerized system (manufactured by Northfab) has been heating the school since January 1986. The boiler and chip handling equipment were factory assembled in a standard 40 foot shipping container and then "plugged in" to the school's existing heating system. This concept is especially practical for retrofitting institutional buildings.

Fuel supply is presently by the supplier to Newfoundland Hardwoods. Alternatives would be chips from a one-person operation or residues from sawmills.

Costs

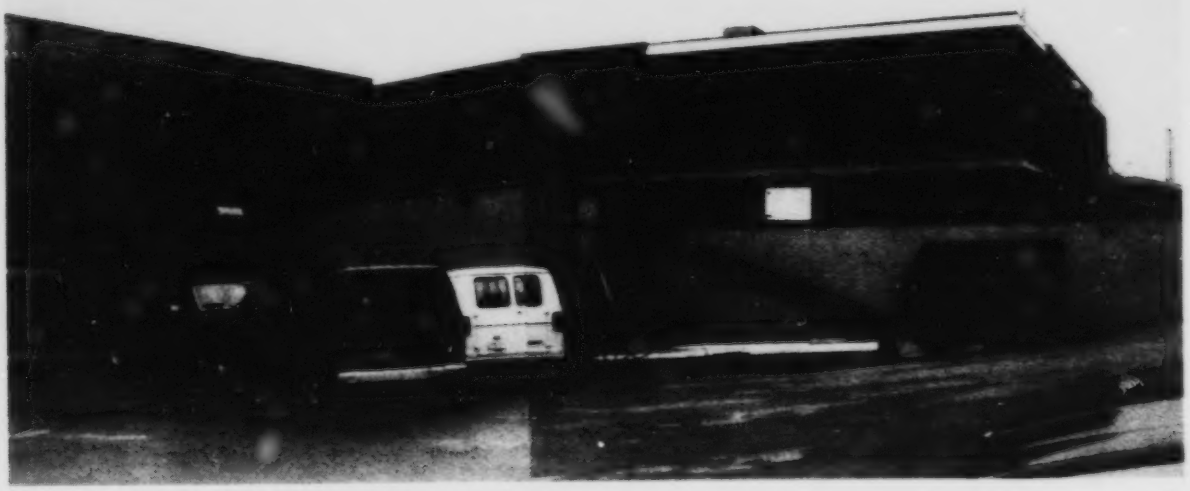
Total:	$207,000 (CDN)	
	Dept. of Works, Services, and Transportation	$93,000
	Newfoundland Dept. of Mines and Energy	56,000
	Energy, Mines and Resources Canada	58,000

Benefits/Savings

1.6 GWh/yr from 700 tonnes wood chips; displaced 200,000 liters of #2 oil. Simple payback: 5 years.

Information Contact

D. Taylor
Director of Operational Support
Dept. of Government Services
P.O. Box 4750
St. John's, NF A1C 5T7
Phone: (709) 576-3367



Newfoundland Hardwoods Wood Boiler

Newfoundland

Technology
Process steam and space heating

Location
Clarenville, Nfld.

End User
Newfoundland Hardwoods Ltd. - Industrial Sector

Proponent
Newfoundland Hardwoods Ltd. - Industrial Sector

Fuel
Whole tree chips

Alternate Fuel
#6 Oil

Status
Operating
(Cogeneration phase under development)

Description

This system (manufactured by Northfab and erected by Hardwoods personnel) has been operational since 1984, providing all of the steam required by the asphalt and creosote plant. It is an excellent demonstration of a cost-effective industrial wood chip burning operation.

Fuel supply is whole tree chips, at a cost of $33.50 (CDN) per tonne under a 3-year contract.

The incorporation of cogeneration equipment is planned for 1989.

Costs

(Heating system phase only)

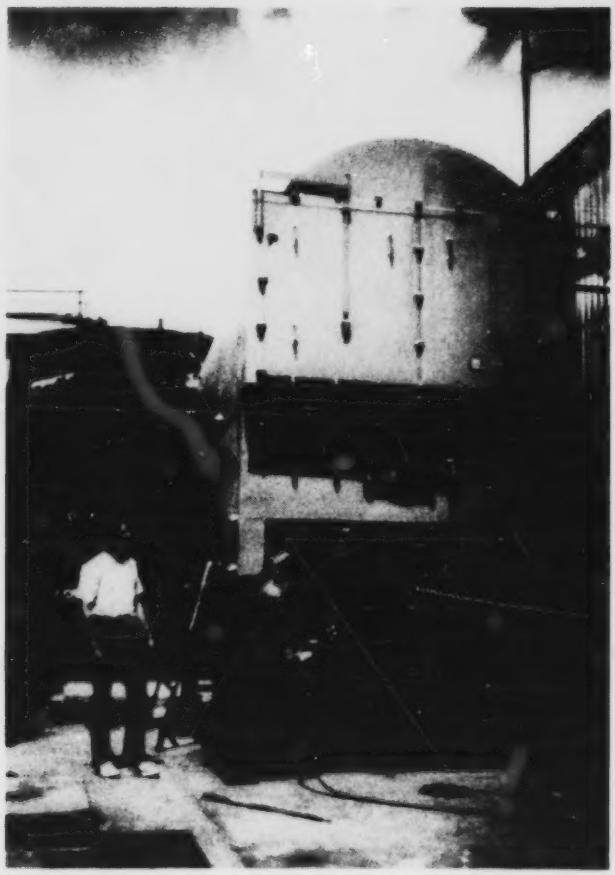
Total:	$587,000
Federal	$130,000
Provincial	132,000
Newfoundland Hardwoods	325,000

Benefits/Savings

13.8 GWh/yr from 5000 tonnes wood chips; displaced 1.4 million liters #6 oil. Simple payback 4.9 years.

Information Contact

Merlin Mills
Newfoundland Hardwoods Ltd.
P.O. Box 40
Clarenville, NF A0G 1J0



Peat Harvesting — Newfoundland

Technology
Fuel production

Location
St. Shotts and Lamaline, Nfld.

End User
Residential and small commercial

Proponent
Avalon Peat Harvesting, and Greater Lamaline Development Association - Commercial Sector

Fuel
Peat (sod)

Status
Operating
(some development ongoing)

Description

Both sites produce peat and sell in raw extruded condition on the bog for about $15 (CDN) per tonne. Purchaser performs turning required for drying, and supplies transportation.

Mechanical turning and harvesting at St. Shotts has been possible, but poor site conditions from heavy equipment have kept this in an experimental phase. Nevertheless, market acceptance in St. John's has been very good at a retail price of about $3.50 per 30 kg bag (equivalent to $116/tonne).

Experiments to optimize peat drainage techniques and bearing capacity are under way conjointly at St. Shotts, and at another site near Markland. Milled peat harvesting has also been demonstrated successfully, but there are no current energy-related operations; the production is used for feedstock in manufacturing. Investigation of wet mining and artificial drying are also in progress.

Costs

Total:	$754,000 (CDN)	
	Energy, Mines and Resources Canada	$283,000
	Newfoundland Dept. of Mines and Energy	71,000
	Rural Agriculture and Northern Dev.	143,000
	CEIC	257,000

Benefits/Savings

4000 tonnes/yr produced: equivalent to 50 GJ

Information Contact

Pat Hewitt, Manager
Avalon Peat Harvesting
St. Shotts, NF A0A 3R0
Phone: (709) 438-2306

Roddickton Electrical Generation — Newfoundland

Technology
Electrical Generation

Location
Roddickton, Nfld.

End User
All Sectors

Proponent
Newfoundland and Labrador Hydro
- Utility

Fuel
Forest and sawmill residue

Alternate Fuel
Diesel

Status
Under Development

Description

The wood-fired plant will provide electricity to the St. Anthony, Main Brook, and Roddickton areas. The project will create 100 jobs during peak construction, 16 direct jobs with Hydro at the plant, and 30-35 direct jobs in wood harvesting. In addition, the plant will provide a steady market for the byproducts of local pulpwood and lumber producers. The plant will enable an estimated $5.3 million reduction in remote electricity subsidy over the 12 year period from 1989-2000.

Costs

Total: $16,000,000 (CDN)
(Newfoundland and Labrador Hydro, and EMR)

Benefits/Savings

23 GWh/yr from 50,000 tonnes wood chips; displacing 9.6 million liters diesel fuel. Simple payback: 25 years.

Information Contact

George Lundrigan
Newfoundland and Labrador Hydro
P.O. Box 9100
Philip Place
St. John's, NF A1A 2X8
Phone: (709) 737-1267

Overview

Wood energy is the most important biomass energy source in Nova Scotia, supplying over 8 percent of end-use demand. In 1984, residential and industrial wood energy use was equivalent to 1.8 million barrels of oil. At current prices (about 22 dollars Canadian per barrel of crude oil), this represents approximately 40 million dollars retained in the provincial economy each year.

Non-residential wood fuel consumption amounts to approximately 858,000 green tons (gt) annually (1988) with the forest products sector accounting for about 90 percent of this total. Smaller scale operations (275 to 33,000 gt per year) account for the remainder. The first major non-forest sector wood energy conversions were large greenhouse operations whose long-term viability was threatened by oil price increases in the early 1980s. More recently, institutional sites (2 hospitals, 2 schools and 1 college) have been constructed or retrofitted with wood combustion facilities.

Government has actively supported growth in the wood energy sector through oil substitution and renewable energy programs funded by the Province and through federal-provincial agreements.

Through its wood energy policies and programs the Province of Nova Scotia expects to improve the security of its energy supply, reduce its dependence on imported oil, enhance its forest resources and increase economic opportunities, particularly in rural areas.

Sunset Adult Residential Center
Wood Chip Fired Boiler

Nova Scotia

Technology
Space Heating

Location
Pugwash, N.S.

End User
Sunset Adult Residential Center

- Institutional Sector

Proponent
Sunset Adult Residential Center

- Institutional Sector

Fuel
Wood Chips

Alternate Fuel
#2 Oil

Status
Operating

Description

In 1986, Sunset Adult Recreational Center installed a 1.4 MMBtu/hr Trent Industries wood-fired boiler. The system uses about 990 tons of wood chips annually to supply steam for space heating and for kitchen and laundry operations. The boiler and fuel bin are housed in a new concrete building with metal cladding and a wood trussed roof which was built by Sunset's own staff to reduce costs. A cement block partition separates the boiler room from the fuel bin. Inclined doors allow access to the fuel bin for delivery and the area is graded to allow trucks to dump directly into the bin from the rear of the building.

Costs

$275,000 (CDN)

Benefits/Savings

First year: $25,000

Information Contact

Ken Jupp
P.O. Box 130
Pugwash, NS B0K 1L0
Phone: (902) 243-2571

Avon Valley Greenhouses Wood Chip/ Residue Fired Boiler

Nova Scotia

Technology
Greenhouse space heating

Location
Falmouth, N.S.

End User
Avon Valley Greenhouses Ltd. - Agricultural Sector

Proponent
Avon Valley Greenhouses Ltd. - Agricultural Sector

Fuel
Wood chips and wood waste

Alternate Fuel:
#6 Oil

Status
Operating

Description

In the fall of 1984, Avon Valley Greenhouses Ltd. installed a packaged combustion and wood handling system manufactured by Bruks Ltd. of Sweden. The system includes an elevated dumping area, outdoor storage for 550 green tons of wood waste, a 100 hp wood hog, a 35,000 cubic foot covered storage area, conveyors, a 20 MMBtu/hr pre-combustion chamber, an ash collection system, a 100 hp induced draft fan, and a new chimney. The unit consumes approximately 17,000 tons of wood fuel annually.

Costs

Total:	$973,000 (CDN)	
	Avon Valley Greenhouses Ltd.:	$624,000
	Nova Scotia/Canada:	250,000
	Forest Industries Renewable Energy Program:	99,000

Benefits/Savings

Annual: $337,000

Information Contact

F. Thomas Cowl
Town Road
Falmouth, NS B0P 1L0
Phone: (902) 798-8381

Nova Scotia Agricultural College
Wood Chip Fired Boiler

Nova Scotia

Technology
Space Heating

Location
Truro, N.S.

End User
Nova Scotia Agricultural College
- Institutional Sector

Proponent
Nova Scotia Department of Government Services
- Provincial Government

Fuel
Wood Chips

Alternate Fuel
#2 Oil

Status
Operating

Description

The Nova Scotia Agricultural College offers undergraduate degree and technology programs in a variety of agricultural specialties. In 1988 a new wood energy facility was constructed on the campus. The estimated consumption of wood chips in the first year of operation is about 7000 tons. A 12,000 lb/hr Matheson boiler is fired by a KMW Energy System furnace which produces steam for the College's existing underground steam distribution system.

Costs

$1.132.000 (CDN)

Benefits/Savings

No data collected to date.

Information Contact

Phil Talbot
Nova Scotia Agricultural College
P.O. Box 550
Truro, NS B2N 5E3
Phone: (902) 895-1571

Hatfield's IGA Cardboard-Fired Boiler — Nova Scotia

Technology
Space and hot water heating

Location
Springhill, N.S.

End User
Hatfield's IGA
- Commercial Sector

Proponent
Hatfield's IGA
- Commercial Sector

Fuel
Cardboard

Alternate Fuel
#2 Oil

Status
Operating

Description

In 1982 Hatfield's IGA, a retail grocery outlet, purchased a cardboard/wood burning furnace to replace two oil furnaces and an oil-fired hot water heater. In 1985, a baler was added to the system to improve fuel handling and to provide better combustion control. Water heated by the boiler is piped to a heat exchanger in the store's existing space heating system. A 1,100 gallon insulated hot water tank allows excess heat from the system to be stored for use at night and other periods when no one is available to fuel the boiler.

Costs

Total:	$35,722 (CDN)	
Hatfield's IGA:		$14,941
Nova Scotia/Canada:		20,781

Benefits/Savings

Annual: $8,247

Information Contact

Al Hatfield
P.O. Box 310C
Springhill, NS B0M 1X0
Phone: (902) 597-3979

Overview

Prince Edward Island has rich agricultural land, and is 48% forested, so biomass energy opportunities do exist here. The province does not, however, have indigenous fossil fuels in commercial quantities. As a result, about 75% of Island energy currently comes from imported petroleum, and 10.5% from imported electricity (via submarine cable). About 14% comes from Island-produced biomass — with 86% of that coming from roundwood (cordwood), 8% from garbage, and 6% from wood chips.

Wood is the Island's primary biomass fuel. Roundwood has always been a major residential heating fuel here, and is still used in approximately 55 per cent of Island households. But wood chips have been the key to extending wood-fuel use to other sectors. The P.E.I. Government has taken a leadership role in promoting the use of wood chips by institutions, industries, and other large-scale users.

The Government has also used the growing market for wood chips as a tool to help upgrade Island forests. Clearing forest land for replanting is expensive if there is no market for the existing trees. Even non-merchantable "junk" trees, however, make perfectly suitable wood chips, and the newly-created demand for chips has enabled additional land to be cleared and planted.

In the early 1980s, the Government realized that for locally-produced wood chips to become a viable energy option steps had to be taken to get past the initial supply/demand dilemma: organizations won't convert unless there is a reliable supply of chips, yet without a steady demand there will be no suppliers. To create the demand, the Provincial Government converted many of its own facilities to burn wood chips, installed two small wood-heated district heating systems, and it promoted wood heat among government supported institutions such as hospitals and schools. With this level of demand insured, private-sector operators willingly entered into long-term contracts to supply chips, and invested in chipping and transporting equipment.

Forest improvement activities could be speeded up if there were a larger market for chips — a market of the scale which a 15 MW chip fired cogeneration plant or several large district heating systems would create. The Government of Prince Edward Island is currently investigating several such projects. The energy value and forestry value of wood chip technology has been clearly demonstrated by the projects of the 1980s; it now seems time to increase the scale of the activity.

Cogeneration at Energy-From-Waste Plant

Prince Edward Island

Technology
Cogeneration

Location
Parkdale, P.E.I.

End User
Energy-From-Waste Plant
- Institutional Sector
- Provincial Government

Proponent
Prince Edward Island Energy Corporation

Fuel
Municipal garbage and trash

Alternate Fuel
No. 2 oil (start-up only)

Status
Turbine-generator operating since June 1987. Energy-From-Waste plant operating since April 1983.

Description

P.E.I.'s Energy-From-Waste plant has become the primary municipal waste disposal facility for 40,000 to 50,000 people in the greater Charlottetown area. The plant, in fact, now produces more steam than its current customer (a large hospital complex) can use. Some of the excess capacity was recently put to good use. A back-pressure turbine and a 180 kW electrical generator were installed, and this arrangement now provides more than half of the electrical energy needed to operate the plant.

Costs

Total:	$315,000 (CDN)	
	P.E.I. Energy Corporation:	$160,000
	Energy, Mines and Resources Canada:	155,000

Benefits/Savings

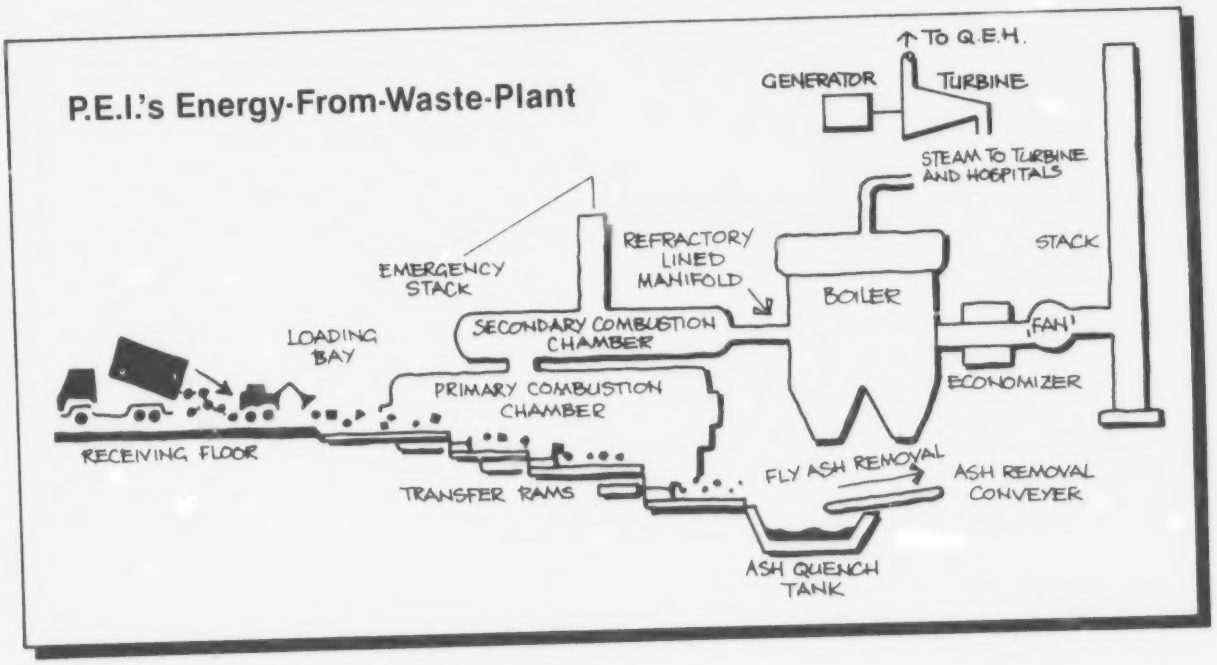
The generator provides 50 to 60 per cent of the electrical energy used by the plant, thereby reducing the plant's electric bill by $5000 to $6000 per month.

The plant as a whole currently consumes 30,000 tonnes of municipal waste per year and produces 48 million kg of steam. About 38 million kg of this is used to heat and cool the hospital complex.

Information Contacts

Dr. John teRaa
P.E.I. Energy Corporation
P.O. Box 2000
Charlottetown, P.E.I. C1A 7N8
Phone: (902) 368-4220

Mr. Peter Klaassen
Branch Manager
Tricil, Inc.
P.O. Box 2518
Charlottetown, P.E.I. C1A 8C2
Phone: (902) 892-1085



University of Prince Edward Island Wood Chip Fired District Heating System

Prince Edward Island

Technology
Wood-fired district heating

Location
Charlottetown, P.E.I.

End Users
University buildings, plus 31 nearby business, apartment, and institutional buildings -Institutional and Commercial Sectors

Proponent
U.P.E.I., and the Prince Edward Island Energy Corporation - Institutional and Government Sectors

Fuel
Whole-tree wood chips

Alternate Fuel
No. 6 oil (peak heating and backup)

Status
Fully operational. Campus wood-heated since 1987. District heating system completed in 1988.

Description

This is the largest wood chip heating system currently operating on P.E.I. A microcomputer-controlled 3.6 megawatt wood chip fired boiler on the campus (Sylva Energy Systems design) feeds a state-of-the-art distribution system, delivering heat not only to University buildings, but also to 31 subscriber buildings. This distribution system employs Scandinavian technology: preinsulated steel pipe, electronic leak detection, building heat exchangers, and heat meters. The distribution medium is hot water at a temperature of 80 to 120° C.

Costs

Wood-fired boiler: $1.6 million (CDN), 51 percent of which was funded by the University, and 49 per cent by Energy, Mines and Resources Canada.

District heating system: $4.3 million, of which the P.E.I. Energy Corporation contributed 2.4 million and the Federal government $1.9 million.

Benefits/Savings

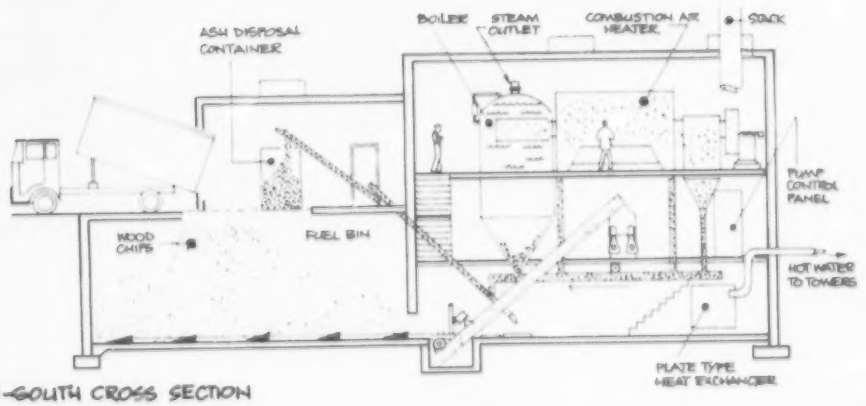
The 9000 green tonnes of wood chips consumed each year displaces almost 2 million litres of imported oil. The cost of this oil — about $450,000 — remains in the local economy creating, for one thing, employment in the forestry sector.

Information Contacts

Dr. John teRaa
P.E.I. Energy Corporation
P.O. Box 2000
Charlottetown, P.E.I. C1A 7N8
Telephone: (902) 368-4220

Mr. Don Coles
Director, Physical Plant
University of Prince Edward Island
550 University Avenue
Charlottetown, P.E.I. C1A 4P3
Telephone: (902) 566-0390

Wood Chip Combustion Unit
U.P.E.I.



NORTH-SOUTH CROSS SECTION

Charlottetown District Heating System Expansion, and Possible Cogeneration Tie-in

Prince Edward Island

Technology

Today: 1.8 MW wood chip fired district heating system.
Future: Expanded district heating system fed by 40 MW heat output of 15 MW (electrical) cogeneration plant.

Status

District Heating system operational since September 1986. Some expansion planned for 1989. Cogeneration and large scale expansion anticipated in 1991-93.

Location

Charlottetown, P.E.I.

Proponent

Prince Edward Island Energy Corporation
- Provincial Government

End User

Businesses and institutions in central Charlottetown
- Commercial/Institutional Sectors

Fuel

Whole-tree wood chips

Alternate Fuel

No. 6 Oil
(peak heating and backup)

Description

Downtown Charlottetown's present district heating system was the first in Canada to use modern European DH technology in combination with low cost, locally available wood chip fuel. The existing system supplies heat to 15 buildings including the Provincial Administration Building Complex, City Hall, a large hotel, two churches, and two motels. Some expansion of the system is planned for 1989, but a much larger expansion is currently being considered in which a wood-fired 15 MW electrical, 40 MW heat, cogeneration plant would be built in the Charlottetown area. The U.P.E.I. and downtown district heating systems would be interconnected, expanded, and linked to the Energy-From-Waste facility. About 19,700 meters of heat lines would be added to the present 7300 meters, and the total number of subscribers would rise from the present 40 or so to about 410.

Costs

Cost of present in-place system was $1.87 million, of which $0.64 million came from the Biomass Conversion Program of Energy, Mines and Resources Canada and $1.24 million came from the P.E.I. Energy Corporation. Capital cost of the large-scale expansion and cogeneration plant would be $44.3 million.

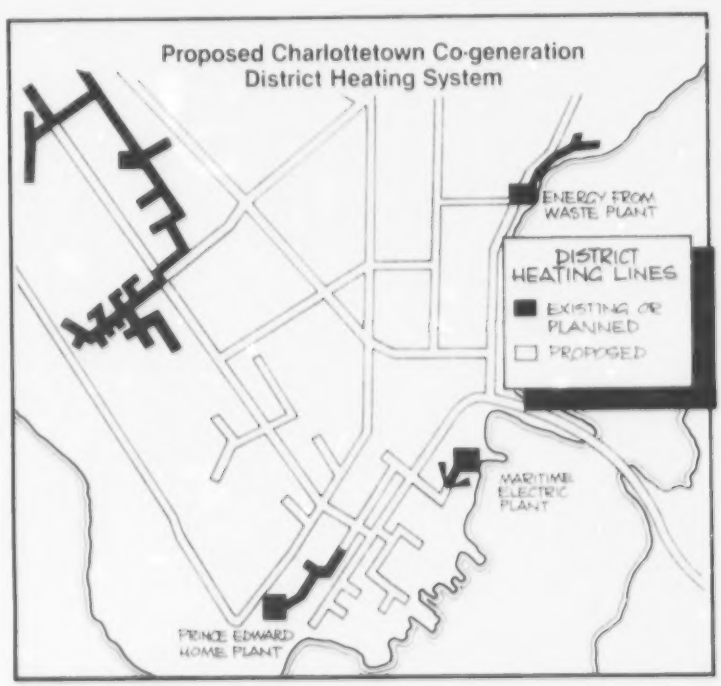
Benefits/Savings

This system currently consumes about 4500 green tonnes of wood chips per year, displacing about 1.2 million litres of oil.

With the cogeneration plant on line and the large-scale DH expansion implemented, annual consumption of wood chips would rise by a factor of almost thirty, to 128,000 green tonnes.

Information Contact

Dr. John teRaa
P.E.I. Energy Corporation
P.O. Box 2000
Charlottetown, P.E.I. C1A 7N8
Phone: (902) 368-4220



Heating Schools with Wood Chips — Prince Edward Island

Technology
Space and district heating by wood chip combustion

Location
Kings County, P.E.I.

End User
Five schools
- Institutional Sector

Proponent
Unit 4 School District
- Institutional Sector

Fuel
Whole-tree wood chips

Alternate Fuel
No. 2 oil
(peak heating and backup)

Status
Fully operational

Description

The Unit 4 School Board serves the eastern end of Prince Edward Island, and has been involved with the wood heating of schools since 1982. It now operates more wood heating systems than any other school board in the country. In Montague, the 730 kW boiler heats the 9800 m2 high school: heat is also piped 128 meters to the 1870 m2 junior high school. In Souris, the 590 kW boiler in the 6100 m2 high school feeds heat through a 178 meter line to the 4700 m2 consolidated school. Heat transmission to the two satellite schools is via hot water (93° C max) through buried, insulated, fiberglass pipe.

Costs

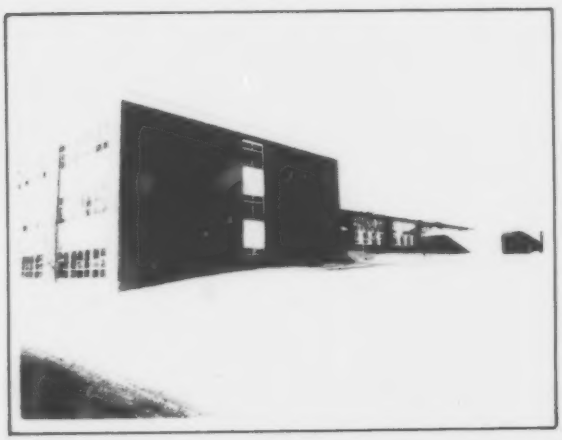
Total capital cost of these projects was approximately $770,000 (CDN), of which $320,000 was contributed by the Federal government.

Benefits/Savings

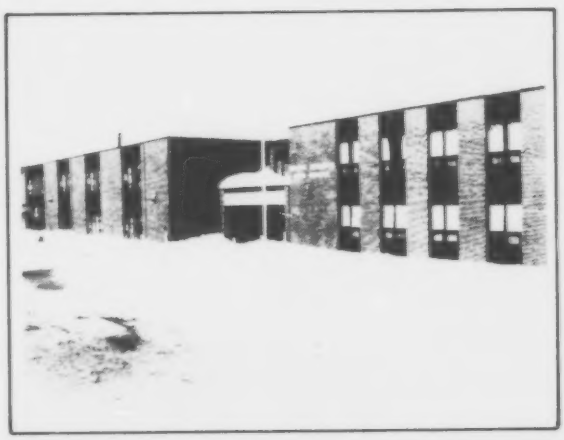
The approximately 1100 green tonnes of chips consumed each year by these systems displaces 242,000 litres of oil worth $48,000. As a result, the Unit spends about $17,200 less each year on fuel than it otherwise would. Furthermore, most of the $30,800 now being spent for wood chips stays in the local economy and helps create local employment.

Information Contact

John Miodowski, Maintenance Superintendent
Regional Administrative Unit 4
P.O. Box 700
Montague, P.E.I. C0A 1R0
Phone: (902) 838-2944



Montague Sr. High School



Souris High School

Overview

The Quebec Government's energy policy accords particular importance to energy efficiency. Energy production from biomass, including urban biomass, is one of the mainstays of this policy. Given Quebec's available biomass supplies, increased biomass energy use will result in higher company profits and more diversified energy supply sources.

Moreover, biomass energy production will reduce needless resource depletion and prolong the service life of sanitary landfill sites.

Biomass energy production projects currently under study will contribute some 300 MW (thermal) to Quebec's energy supply in the medium term.

To attain its objectives, the Ministry of Energy and Resources of Quebec (MER) helps finance demonstration projects and studies aimed at converting approximately 1 million tonnes of urban biomass into energy in the medium term. Given that 550,000 tonnes of biomass are already being converted into energy, approximately half of Quebec's urban biomass should produce energy by the year 2000.

The MER is currently studying several projects involving co-generation through incineration and solid fuel production using urban and forest biomass. These are the only proven technologies for converting waste into energy available in the short term at quantifiable costs.

Hospital Waste Modular Incinerator with Energy Recovery at the Notre Dame Hospital in Montreal

Quebec

Technology

Process steam by modular incinerator technology (Pyrox primary and secondary chambers, Volcano boiler)

Location

Montreal, Que.

End User

Notre Dame Hospital
- Institutional Sector

Proponent

Notre Dame Hospital
- Institutional Sector

Fuel

Hospital waste (500 kg/hr)

Status

Start-up, demonstration project

Description

The Notre Dame Hospital Modular Incinerator now in start-up period has a nominal capacity of 500 kg/hr of hospital waste. Combustion chambers, automatic ram feeder, and ash removal system are manufactured by Pyrox, a Quebec company. A high energy venturi and packed tower with pH control from American Air Filter is used for gas treatment. The incinerator produces up to 4 tons of steam per tonne of waste.

Costs

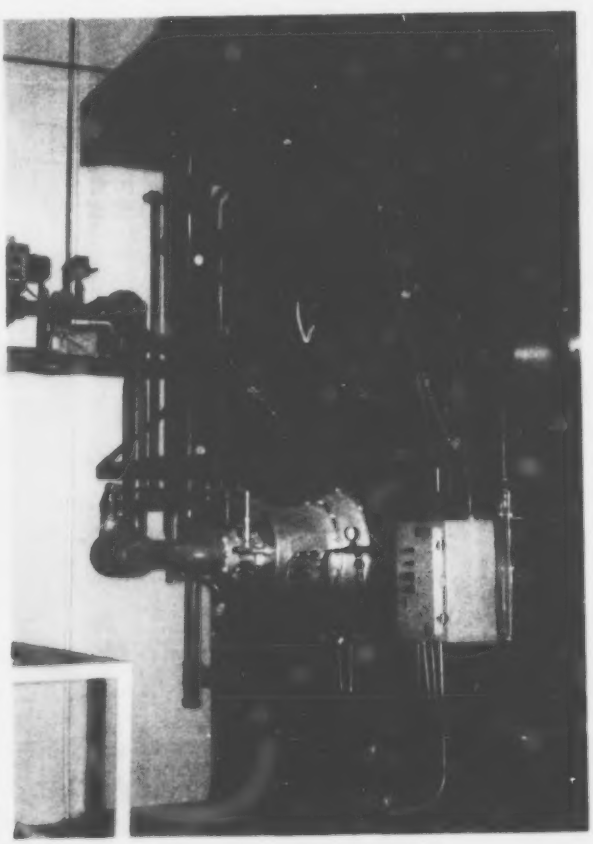
Capital cost was approximately $1.3 million (CDN) including a $390,000 grant from provincial and federal governments.

Benefits/Savings

The amount of energy produced from 3000 tons of waste per year is in the order of 7.2 million kWh per year. The hospital will save at least $60,000 per year in tipping fees, and $140,000 per year in oil consumption. The simple payback is about 6 years.

Information Contact

Mr. Pierre Chenier, eng.
Directeur des services auxiliares
Hopital Notre-Dame
1560, rue Sherbrooke Est
Montreal, Quebec H2L 4M1
Phone: (514) 876-6785



Steam Production for District Heating from Des Carrieres Incinerator

Quebec

Technology

Steam production by mass burning technology (Von Roll furnaces and Dominion Bridge boiler). Underground steam piping network for district heating (10 km length).

Location

Montreal, Que.

End User

Twenty space heating and industrial steam customers - Industrial and Institutional Sectors

Proponent

City of Montreal

Fuel

Municipal waste

Status

In service for 20 years (incinerator) and 5 years (district heating network)

Description

The Des Carrieres Incinerator has been in service since 1969. It has a nominal capacity of 1,200 tons per day and includes 4 Von Roll furnaces, each one integrated with a Dominion Bridge boiler. Only 3 furnaces are in operation, the 4th furnace is for standby purposes. This plant can produce around 600,000 tons of steam per year and utilize this energy for municipal building and district heating (20 customers.)

Costs

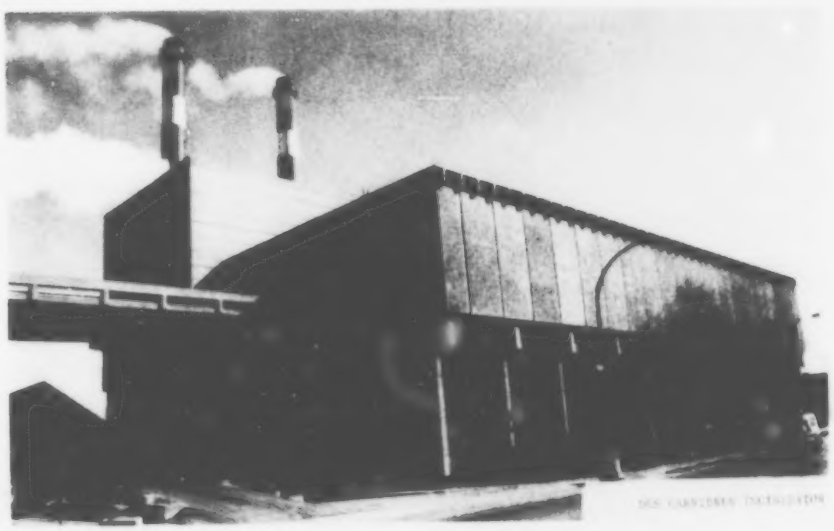
The capital cost was about $15 million (CDN) in 1969. A similar plant in 1989 would cost up to $100 million. In 1984 the City of Montreal invested $9 million (with $2 million in grants from the Governments of Canada and Quebec) to install the district heating network.

Benefits/Savings

This plant displaces about 270,000 barrels of imported oil per year (or an equivalent amount of natural gas). The simple payback of the steam network is about 4 to 5 years.

Information Contact

Henri M. Bonneilh, eng.
Incineration Manager
Des Carrieres Incinerator
1266, rue des Carrieres
Montreal, Quebec H2S 2A8
Phone: (514) 872-3592



Resource Recovery from Scrapped Tires by a New Pyrolysis Process

Quebec

Technology
Vacuum pyrolysis

Location
Saint-Amable, Que.
(Near Montreal)

End User
Industrial Sector

Proponent
Laval University

Fuel
Scrapped tires are transformed into pyrolytic oil (#3 fuel oil) and carbon black

Status
Pilot plant

Description

The vacuum pyrolysis pilot unit has a 200 kg/hr output on a continuous basis. The tests that have been carried out have given good performance in terms of quantity and quality of oil and carbon black (55 and 30% by weight respectively). Some technical modifications of the reactor are now required to optimize the performance of the system. The total cost of this additional work (currently in the planning stage) would be about $750,000.

Costs

The pilot plant development and research costs to date are about $1 million (CDN). The Governments of Canada and Quebec have contributed approximately $500,000 and are now considering a request from Laval for additional funds to complete the R&D work. The final step will be to build a commercial plant which should require an investment of $4.5 million.

Benefits/Savings

The proposed plant would solve a pollution problem. The planned facility should be able to convert 20,000 tons of used tires into 11,000 tons of #3 fuel oil and 6,000 tons of carbon black — an ingredient needed for the production of certain types of rubber. The simple payback is estimated to be less than 5 years.

Information Contact

Dr. Christian Roy
Professor
Dept. of Chemical Engineering
Laval University
Quebec, Quebec G1K 7P4
Phone: (418) 656-7406

Steam Production from Quebec Metro Incinerator

Quebec

Technology

Process steam production by mass burning technology (Von Roll furnaces and Dominion Bridge boiler)

Location

Limoilou (Quebec City)

End User

Daishowa Paper
- Industrial Sector

Proponent

Quebec Urban Community

Fuel

Solid municipal waste (220,000 tons per year)

Status

In service for 15 years. Important ongoing modernization program ($25 million)

Description

The Quebec Metro Incinerator was built between 1972 and 1975. It has a nominal capacity of 907 metric tons (1000 short tons) per day and includes 4 Von Roll furnaces, each one integrated with a Dominion Bridge boiler. The incinerator produces an average of 2.7 tons of steam per ton of refuse, and 2.2 tons of this is delivered to Daishowa Paper.

Costs

Capital cost was in the order of $25 million (CDN) in 1972. The same plant in 1989 would cost between $80 and $100 million. This incinerator was paid for entirely by Quebec Urban Community.

Benefits/Savings

The amount of energy produced is about 600,000 tons per year of high pressure steam, from 220,000 tons per year of refuse. This plant displaces about 200,000 barrels of imported oil annually. Also, the direct revenue from the sale of steam covers an important part of the cost of operation.

Information Contact

Herve Aubin, eng.
Director of Engineering Department
Quebec Urban Community
399, rue Saint-Joseph Est
Quebec, Quebec G1K 8E2
Phone: (418) 529-8771

State of Rhode Island and Providence Plantations

Overview

Rhode Island currently has no biomass projects in operation. Two promising projects using wood waste have been proposed, but neither has a power contract for all of its output, nor a secured site. One project was proposed at 26 megawatts but may be downsized. The other will be 20 megawatts, attained by phasing in 5 megawatt units.

Information Contacts

Aaron Samson
Kenetec Energy Systems (KES)
1 Research Parkway
Meriden, CT 06450

Peter Wallis
Tamal Development Corporation
33 Boston Post Road West, Suite 270
Marlborough, MA 01752

Overview

Vermont, the Green Mountain State, is endowed with a vast forest resource which covers approximately 80% of the land mass. In previous years, as many as 50% of the homes have burned wood as the primary heat source, although this has dropped recently due to the low cost of oil.

Biomass energy systems continue to be a viable energy option. Using a renewable, natural resource for fuel, such as wood chips, is quite feasible and keeps hard earned dollars here in the State of Vermont. In addition, wood chip fuel costs considerably less than oil.

Over 75 state-owned buildings and many commercial buildings utilize biomass energy for process steam or space heating. The Conservation and Renewable Energy Unit of the Department of Public Service continues to provide technical assistance to private, public, and commercial groups — especially with regard to the conversion of fossil fuel systems to indigenous biomass fuels.

For further information contact Norm Hudson, Wood Energy Specialist, or Stuart Slote, Energy Engineer, Vermont Department of Public Service, CARE Unit, State Office Building, Montpelier, Vermont 05602, telephone (802) 828-2393.

Calais Elementary School — Vermont

Technology
Space heating

Location
Calais, Vermont

End User
Calais Elementary School
- Institutional

Proponent

Fuel
Wood chips and sawmill residues

Alternate Fuel
Oil

Status
Operating

Description

As part of a school energy retrofit project, a 300,000 BTU/hr automatic wood-fired hot water boiler was added to provide space heating to a 12,950 sq. ft. school. The system consumes about 170 tons of wood chips per year.

Costs

Wood burning system:	$70,000 (US)

Benefits/Savings

Previous electricity costs:	$20,000
Wood chip costs:	2,250
Net energy cost savings:	17,750

Information Contact

Tim Maker
P.O. Box 73
Calais, VT 05648
Phone (802) 223-6918

Montpelier City Garage — Vermont

Technology
Space heating

Location
Montpelier, Vermont

End User
Montpelier City Garage
- Institutional

Proponent
City of Montpelier
- Municipal Government

Fuel
Wood pellets

Status
Operating

Description

A 300,000 BTU/hr oil-fired steam boiler providing space heat to a 10,200 sq. ft. school was converted to an automatic wood pellet stoker system. The system consumes about 120 tons of wood pellets per year.

Costs

Wood burning system:	$7,000 (US)

Benefits/Savings

Previous oil costs:	$18,000
Wood pellet costs:	10,000
Net energy cost savings:	8,000

Information Contact

Steven Gray
Public Works Director
Montpelier City Hall
Main St.
Montpelier, VT 05602
Phone: (802) 223-9508

Marty Moore Greenhouse — Vermont

Technology
Space heating

Location
Bennington, Vermont

End User
Marty Moore Greenhouse

Proponent
Marty Moore Greenhouse
- Commercial Sector

Fuel
Wood chips and
sawmill residues

Alternate Fuel
Oil

Status
Operating

Description

A 3,000,000 BTU/hr oil-fired steam boiler providing heat to a 25,000 sq. ft. greenhouse was converted to wood chips. Chipping is done on-site, and fuel is stored in a modified forage wagon. A second boiler remains on oil standby, but has not been used. The entire system consumes about 600 tons of wood chips per year.

Costs

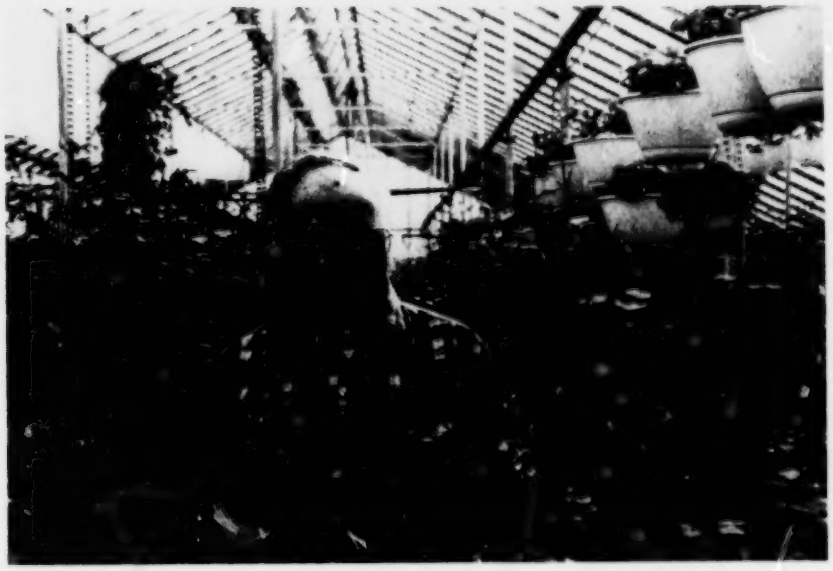
Total:	$34,000 (US)
Wood burning system:	$25,000
Chipper:	5,000
Tractors (used):	4,000

Benefits/Savings

Previous oil costs:	$60,000
Wood cost:	6,000
Labor:	6,000
Net energy cost savings:	48,000

Information Contact

Clover Sweet
Marty Moore Greenhouse
Route 7
Bennington, VT 05201
Phone: (802) 442-2441



The Sprout House — Vermont

Technology
Space heating

Location
Bristol, Vermont

End User
The Sprout House

Proponent
The Sprout House
- Commercial Sector

Fuel
Wood chips and sawmill residues

Alternate Fuel
Oil

Status
Operating

Description

A 350,000 BTU/hr oil/wood-fired hot water boiler providing space heat and process hot water to a 4300 sq. ft. building was converted to an automatic wood chip system. The system consumes about 110 tons of wood chips per year.

Costs

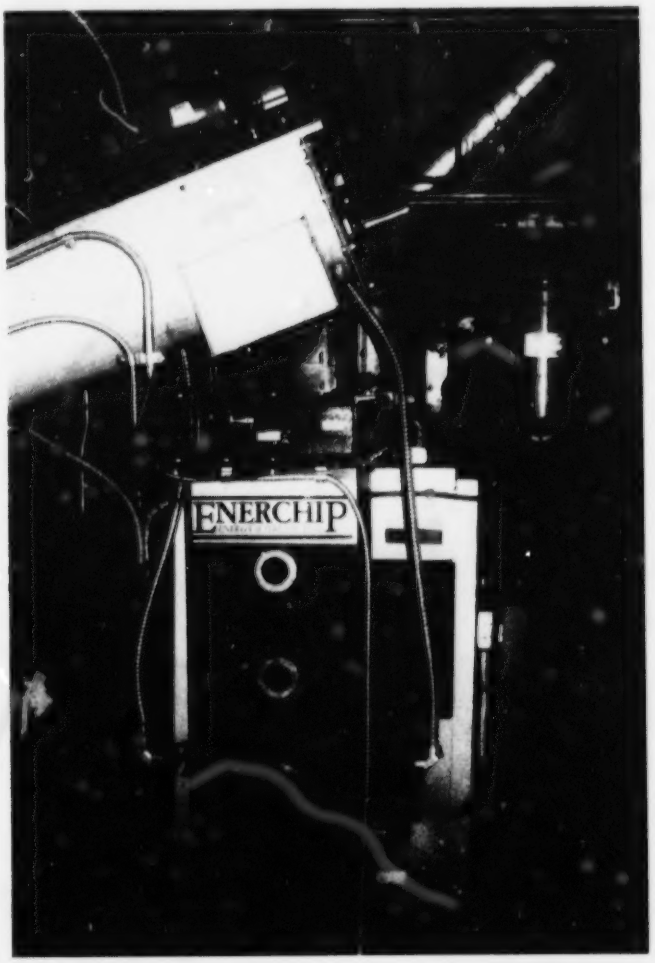
Wood burning system: $15,000 (US)

Benefits/Savings

Previous oil costs:	$6,375
Wood chip costs:	2,475
Net energy cost savings:	3,900

Information Contact

John Tomasi
The Sprout House
Bristol, VT 05443
Phone: (802) 435-4919



Flood Brook Union School — Vermont

Technology
Space heating

Location
Londonderry, Vermont

End User
Flood Brook Union School
- Institutional

Fuel
Wood chips, and saw mill residues

Status
Operating

Description
A 750,000 BTU/hr oil steam boiler providing space heat to a 32,000 sq. ft. school was converted to an automatic wood chip system. The system consumes about 450 tons of wood chips per year.

Costs

Wood burning system:	$55,000 (US)

Benefits/Savings

Previous oil costs:	$20,000
Wood chip costs:	10,000
Net energy cost savings:	$10,000

Information Contact

Mrs. Spaulding
Flood Brook Union School
Londonderry, VT 05148
Phone (802) 824-6979